2-12-1968

Service Propulsion System (SPS) - Malfunction Symptoms 1 - 10 and hand drawn diagrams

National Aeronatics and Space Administration (NASA)

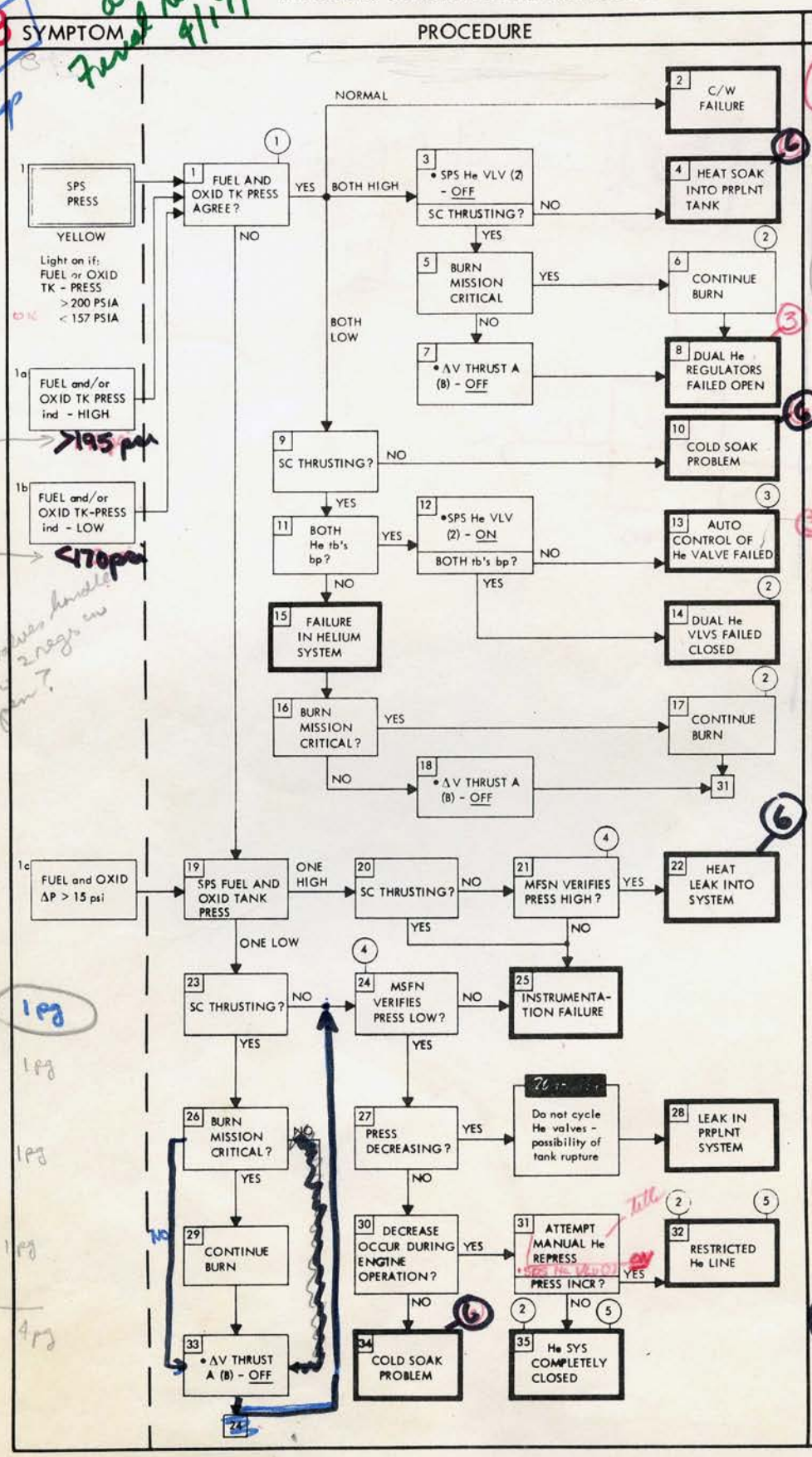
SPS

UP DATE

Additional flows needed!

(see back)

SPS MALFUNCTION



SM-2A-1459

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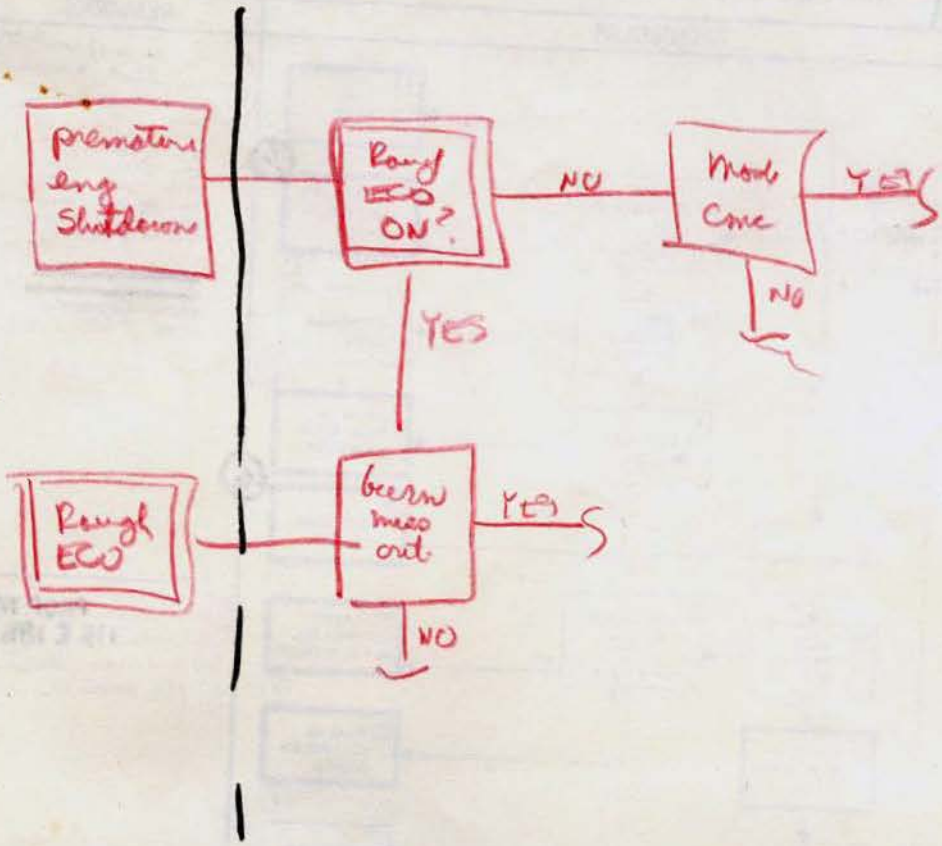
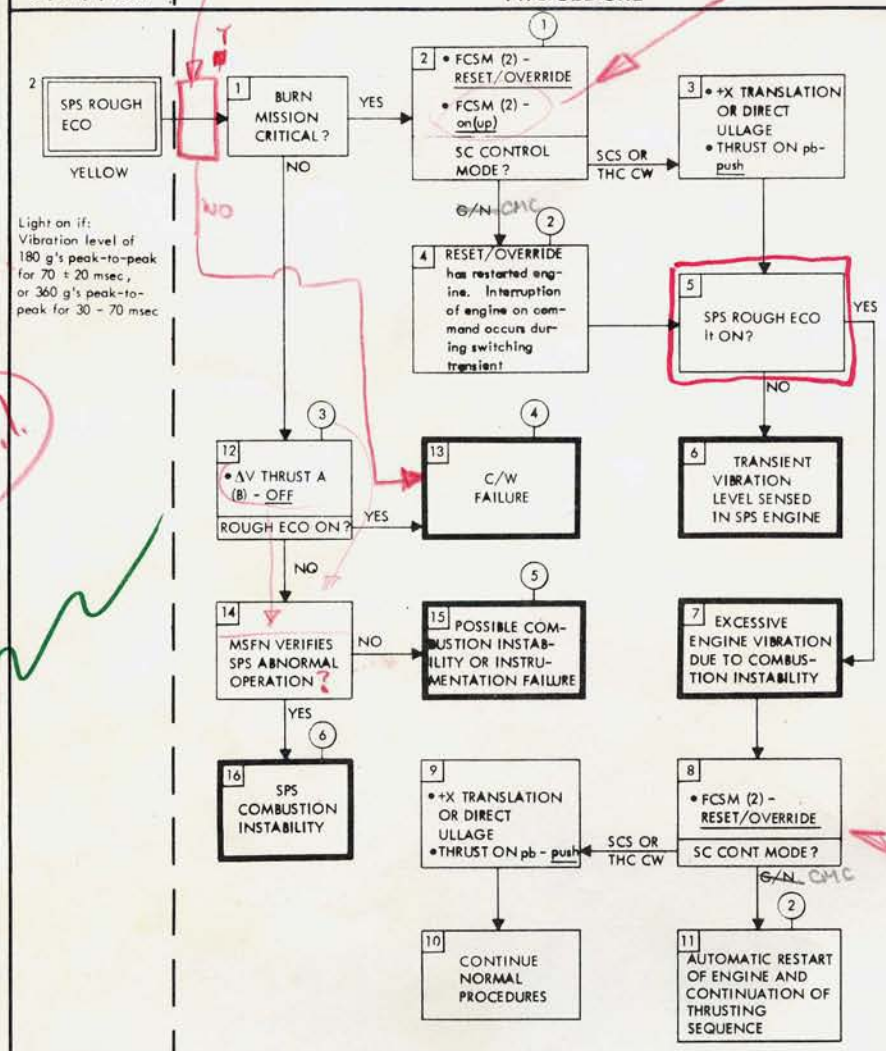

premature eng Shutdown
Rough ECO ON?
NO
Mech Conc
YES
NO
YES
Rough ECO
beam meas out
YES
NO

SYMPTOM

2 SPS ROUGH ECO — YELLOW

Light on if:
Vibration level of 180 g's peak-to-peak for 70 ± 20 msec, or 360 g's peak-to-peak for 30 - 70 msec

PROCEDURE

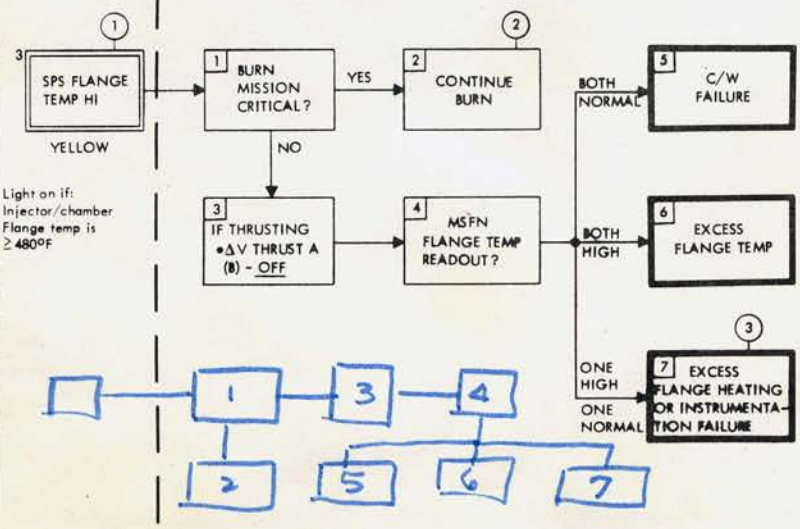


REMARKS

1. SPS ROUGH ECO light will go out when FCSM circuitry is reset. The SPS THRUST SW in DIRECT ON Position also overrides the FCSM monitors.
2. If in G/N ΔV, automatic restart of the engine will occur if < 3 - 4 sec has elapsed since shut-down. If >4 sec, V50 N99 will flash and ENTR must be pushed within (TBD) sec for automatic restart.
3. SPS ROUGH ECO light, is reset when ΔV THRUST - A and B switches are OFF.
4. SPS is fully operable but ROUGH ECO light will remain on for duration of mission.
5. SPS operable but FCSM may terminate subsequent burns.
6. SPS operability dependent upon subsequent investigation.

3 SPS FLANGE TEMP HI — YELLOW

Light on if:
Injector/chamber Flange temp is ≥480°F



1. High flange temp may occur up to TBD minutes following a burn from normal heat soak-back.
2. Flange burn through may be expected at anytime, possible resulting in chamber separation.
3. MSFN can confirm flange temperature over 480° F.

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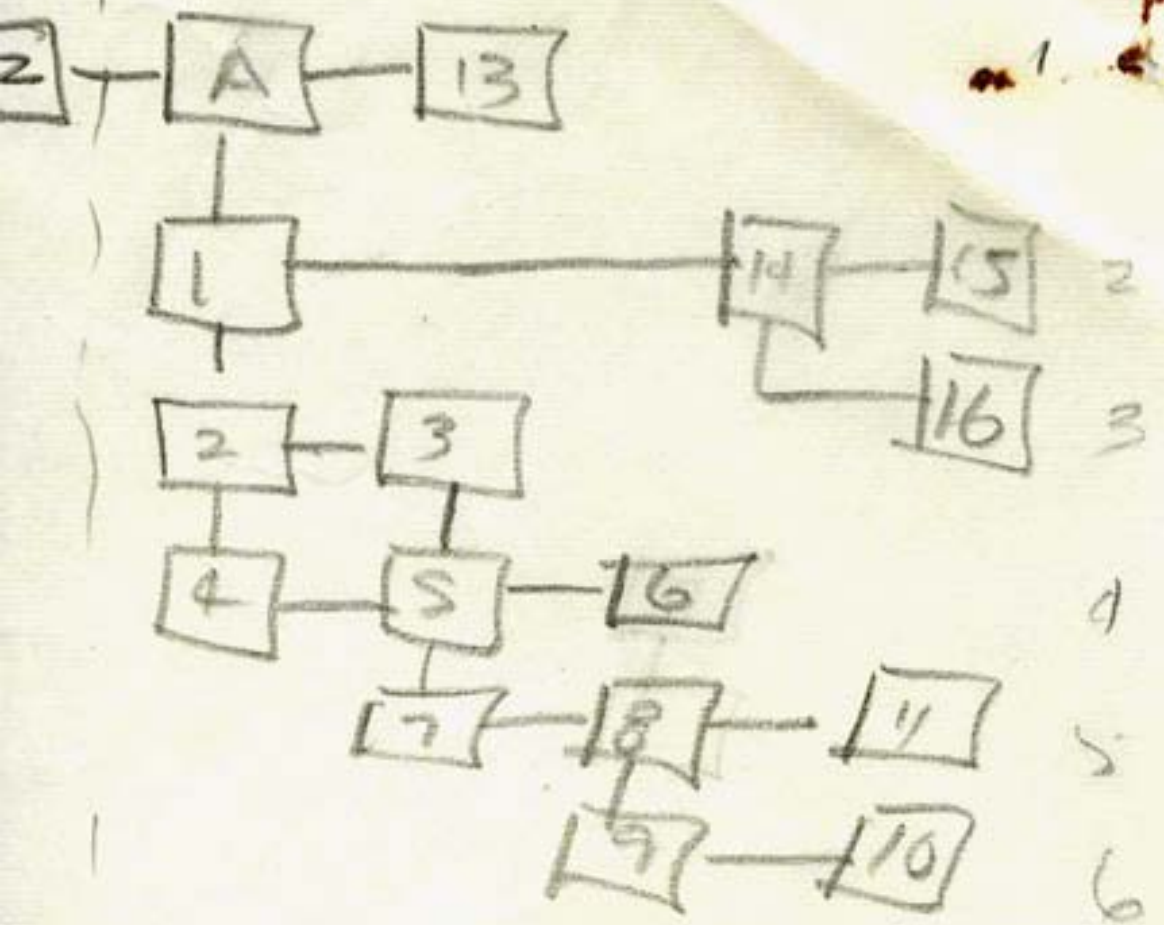
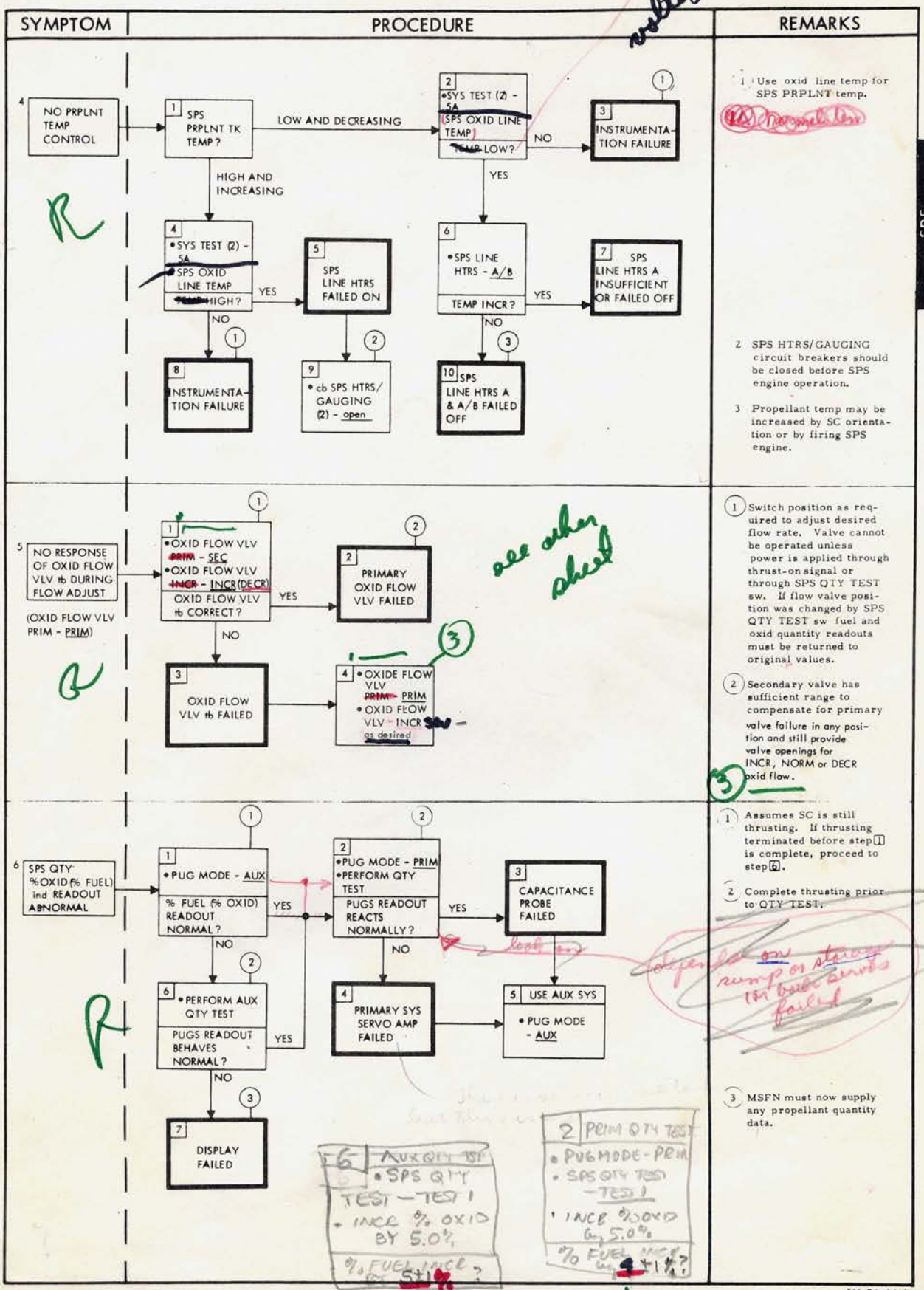


perhaps additional steps req'd



SM-2A-1461

SYMPTOM	PROCEDURE	REMARKS
7 SPS QTY OXID UNBAL ind ERRATIC OR PEGGED	1 • PUG MODE - AUX OXID UNBAL ind NORMAL? YES → 2 PRIMARY UNBALANCE SYSTEM FAILED NO → 3 •PERFORM AUX QTY TEST OXID UNBAL ind NORMAL? YES → 4 PRIMARY UNBALANCE SYSTEM FAILED NO → 5 OXID UNBALANCE FAILED 4 → 6 RETURN TO NORMAL PUG MODE •PUG MODE - PRIM •PERFORM QTY TEST •PUG MODE - NORM	(1) Assumes quantity indicating system normal. (2) Assumes SC is still thrusting. If thrust has terminated, proceed with step 3. (3) If thrusting terminated before step 1 was completed, the AUX sensing system can be checked during the next SPS burn. 4 Actuation of SPS QTY TEST switch here will realign digital display to primary system.
8 HELIUM TANK PRESSURE LOW OR DECREASING	1 MSFN VERIFIES SPS He TANK PRESS LOW OR DECREASING? YES → 2 LEAK IN HELIUM SUPPLY NO → 3 HELIUM INSTRUMENTATION FAILURE	1 MSFN will monitor redundant helium pressure instrumentation. 2 Helium depletion imminent. 3 SPS engine operable until [redacted] engine indications require shutdown.
9 SPS He VLV tb ABNORMAL	1 SC THRUSTING? YES → 2 • SPS He VLV 1 (2) - ON tb's gray? NO → 3 SPS FUEL & OXID PRESS DECREASING → 4 BOTH He VLVS FAILED CLOSED YES → (2) NO → 5 • SPS He VLV 1 (2) - OFF tb's bp? YES → 6 He AUTO MODE MALFUNCTION NO → 7 tb OR ONE He VLV FAILURE 3 → STEADY	(1) SPS engine operable until Pc reaches TBD or until engine indications require shutdown. (2) Control PROP TANK PRESS prev. between 175 & 185 psia by manual actuation of He Valves.

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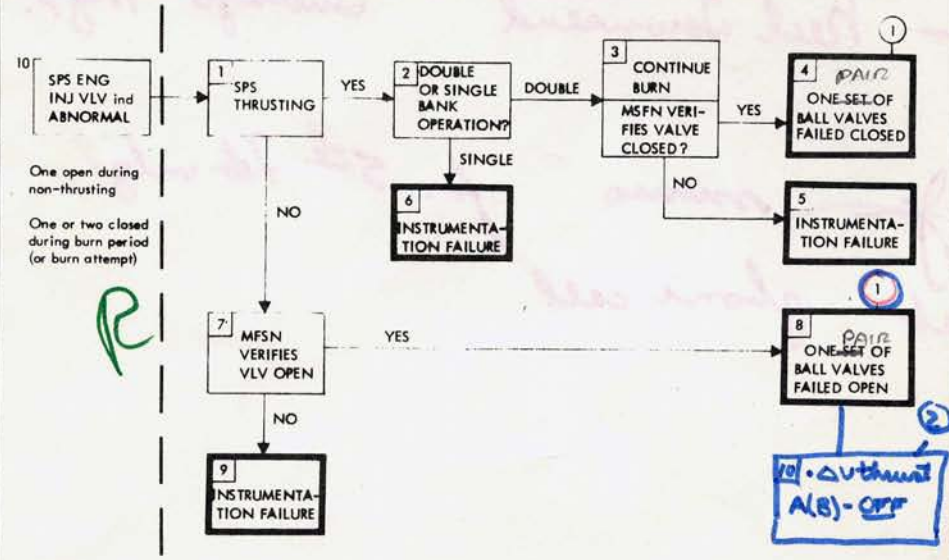
Basic Date _____ Change Date _____ Page _____

SYMPTOM	PROCEDURE	REMARKS



(1) SPS fully operable on redundant bank if one bank failed.

(2) Future ΔV's should use unaffected bank of ball valves.

(2) Failed bank should not be used except in an emergency

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Basic Date _____ Change Date _____ Page _____

RCS - Ralph Tauber Subsys Mgr
SPS - Neil Townsend Subsys Mgr.

19th of Jan memo for 5th Feb mtg.
8 or 9 Feb phone call

SPS Symptoms needed

1) Abnormal SPS P_c
2) Premature engine Shutdown — prime crew operation needed
3) ~~Abort~~ GN_2 pres low.

No. .....

MSC ROUTING SLIP	ASTRONAUT OFFICE	Due Date

Circulate	Coordination	File	Read	Necessary Action	Note and Return	See Me	Signature	Comply	

Name or Title	Initial	Date	Name or Title	Initial	Date
A. Shepard			V. Grissom		
J. Peterson			F. Haise		
E. Aldrin			J. Irwin		
W. Anders			J. Kerwin		
N. Armstrong			D. Lind		
A. Bean			J. Lousma		
F. Borman			J. Lovell		
V. Brand			T. Mattingly		
J. Bull			B. McCandless		
S. Carpenter			J. McDivitt		
G. Carr			C. Michel		
E. Cernan			E. Mitchell		
R. Chaffee			W. Pogue		
M. Collins	C		S. Roosa		
C. Conrad			H. Schmitt		
G. Cooper			W. Schirra		
W. Cunningham	CUR		R. Schweickart		
C. Duke			D. Scott		
D. Eisele			T. Stafford		
J. Engle			J. Swigert RETURN TO		
R. Evans			P. Weitz		
O. Garriott			E. White		
E. Gibson			C. Williams		
E. Givens			A. Worden		
R. Gordon			J. Young		

EXPEDITE

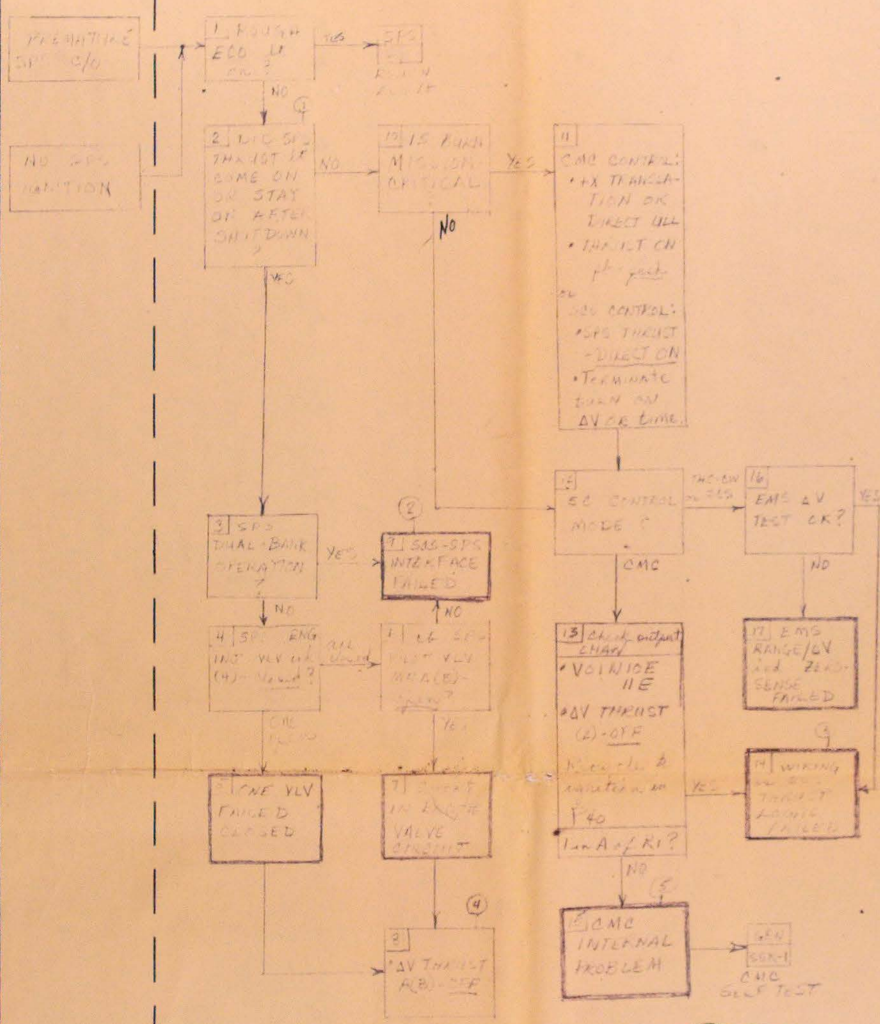
HERE ARE SOME ADDITIONAL SPS PROCEDURES THAT WERE GENERATED AT OUR REQUEST. AT FIRST GLANCE, THERE ARE SOME CHANGES THAT ARE NEEDED. (SEE MY VERSION AT END) COULD I PLEASE HAVE YOUR SUGGESTIONS BY 3/30/68 TO USE AT NAA THE FOLLOWING WEEK

JACK

From	Phone	Date

MSC Form 467 (Jul 62)

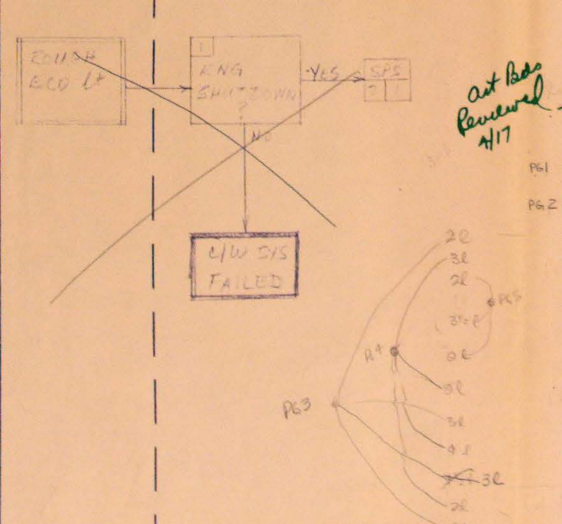
SYMPTOM	PROCEDURE	REMARKS



(2) How about well Direct on sw?

How about Direct on operation for future SV's?

FINAL UPDATE 3-29-68



SPS MAL PROC ORGANIZATION

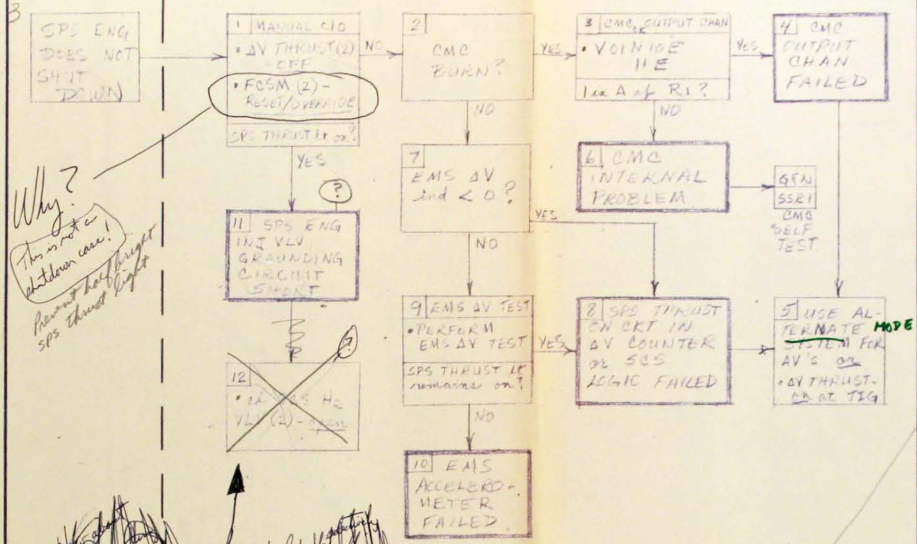
Out Bds Reviewed 4/17

	NEW PROC NO	OLD PROC NO.	
PG1	1	1	SPS PRESS
PG2	2	—	PREMATURE ENG C/O
	2A	—	NO SPS ENG IGNITION
	2B	2	ROUGH ECO LT
PG3	4	3	SPS FLANGE TEMP HI
PG4	10	4	NO PROP TEMP CORR
PG5	11	5	NO RESPONSE OF OXID FLOW VLV during FLOW ADJ
PG5	13	6	SPS QTY OXID (FUEL) IND ERRATIC ABNORMAL
PG5	12	7	SPS QTY OXID UNBAL IND ERRATIC OR POGGED
PG4	7	8	HE TANK PRESS LOWER DECR
PG3	6	9	SC VLV ABNORMAL
PG4	9	10	SPS ENG PRI VLV IND ABNORMAL
PG3	5	—	SPS ENG DOES NOT SHUT DOWN
PG4	8	—	GN2 A(B) PRESS LOW
PG5	5	—	SPS PC ABNORMAL

G&N MALFUNCTION | SCS MALFUNCTION | SPS MALFUNCTION | RCS MALFUNCTION | EPS MALFUNCTION | T/C MALFUNCTION | ECS MALFUNCTION | SEQ MALFUNCTION

SYMPTOM	PROCEDURE	REMARKS

3



Why? This is not a shutdown case! Prevent half bright SPS thrust light

Please explain

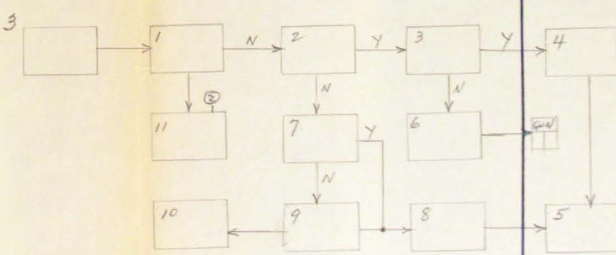
[illegible]

Crew may also see it on their display prior to getting engine off.

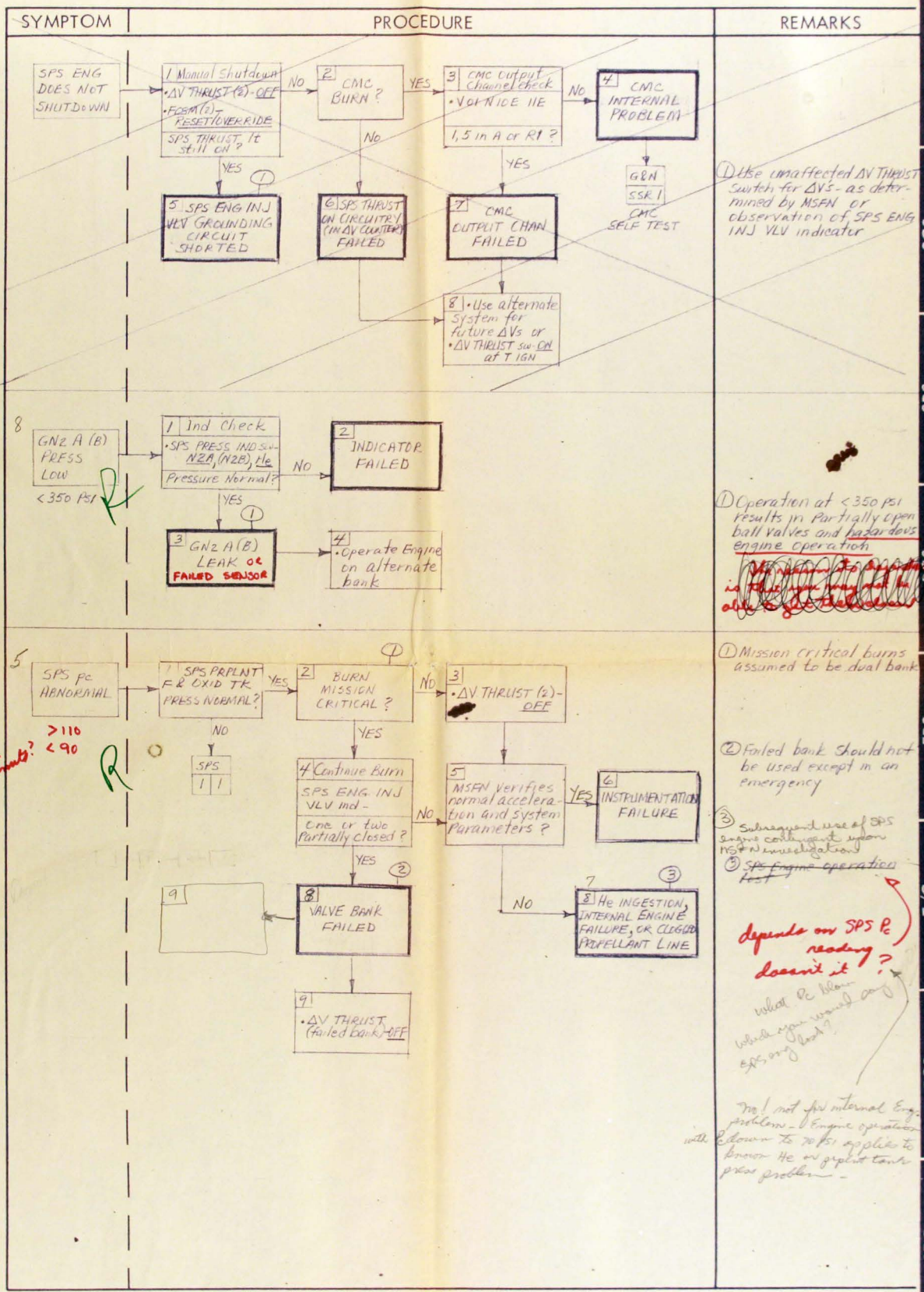
MSFN can verify which bank of ball valves didn't close. C.B. on that system only should be pulled and the corresponding ΔV thrust switch should not be used for remainder of mission. Add A note should say that subsequent burns may be performed normally on remaining good system. Affected system may be used in emergency by placing ΔV thrust switch on at TIG.

③ Subsequent ΔVs should be performed on unaffected bank. (Failed bank can be determined by MSFN from TLM and by crew from SPS INJ valve ind display.) Failed bank may be used in an emergency by placing associated ΔV thrust switch ON at TIG.

3



G&N MALFUNCTION | SCS MALFUNCTION | SPS MALFUNCTION | RCS MALFUNCTION | EPS MALFUNCTION | T/C MALFUNCTION | ECS MALFUNCTION | SEQ MALFUNCTION


SYMPTOM
PROCEDURE
REMARKS
SPS ENG DOES NOT SHUTDOWN
1 Manual Shutdown
•ΔV THRUST (2) - OFF
•FCSM (2) - RESET/OVERRIDE
SPS THRUST, Is Still ON?
YES
NO
2 CMC BURN?
YES
No
3 CMC Output Channel Check
•VOLTAGE IIE
1, 5 in A or R1?
No
YES
4 CMC INTERNAL PROBLEM
G&N SSR 1
CMC SELF TEST
5 SPS ENG INJ VLV GROUNDING CIRCUIT SHORTED
6 SPS THRUST ON CIRCUITRY (IN ΔV COUNTER) FAILED
7 CMC OUTPUT CHAN FAILED
8 •Use alternate system for future ΔVs or •ΔV THRUST sw ON at T IGN
① Use unaffected ΔV THRUST switch for ΔVs - as determined by MSFN or observation of SPS ENG INJ VLV indicator
8
GN2 A (B) PRESS LOW
< 350 PSI
1 Ind Check
•SPS PRESS IND SW - N2A, (N2B), He
Pressure Normal?
NO
YES
2 INDICATOR FAILED
3 GN2 A (B) LEAK OR FAILED SENSOR
4 •Operate Engine on alternate bank
① Operation at < 350 PSI results in Partially open ball valves and hazardous engine operation
5
SPS Pc ABNORMAL
>110
<90
1 SPS PROPLNT F & OXID TK PRESS NORMAL?
YES
NO
SPS 1 1
2 BURN MISSION CRITICAL?
YES
NO
3 •ΔV THRUST (2) - OFF
4 Continue Burn
SPS ENG INJ VLV Ind - One or two Partially closed?
YES
NO
5 MSFN verifies normal acceleration and system Parameters?
YES
NO
6 INSTRUMENTATION FAILURE
7 8 He INGESTION, INTERNAL ENGINE FAILURE, OR CLOGGED PROPELLANT LINE
8 VALVE BANK FAILED
9 •ΔV THRUST (Failed Bank) - OFF
① Mission critical burns assumed to be dual bank
② Failed bank should not be used except in an emergency
③ Subsequent use of SPS engine contingent upon MSFN investigation
depends on SPS Pc reading doesn't it?
What Pc below which you would use SPS, any how?
No! not for internal Eng problems - Engine operation down to 70 PSI applies to known He or propint tank press problem -
G&N MALFUNCTION
SCS MALFUNCTION
SPS MALFUNCTION
RCS MALFUNCTION
EPS MALFUNCTION
T/C MALFUNCTION
ECS MALFUNCTION
SEQ MALFUNCTION